

DESCRIPTION OF A NEW SPECIES OF *HYADINA* HALIDAY
(DIPTERA: EPHYDRIDAE)
FROM SOUTHERN CALIFORNIA

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Abstract.—*Hyadina clauseni*, new species, from Tecopa Hot Springs (California, Inyo County) is described, and information on its natural history is provided. *Hyadina* Haliday is redescribed, its nomenclatural status is discussed, and a revised key to known Nearctic species of the genus is provided.

Key Words: Diptera, Ephydriidae, shore flies, *Hyadina clauseni*, California

The shore-fly genus *Hyadina* Haliday is represented in the Nearctic Region by eight species and one subspecies (Clausen 1983, 1984; Mathis and Zatwarnicki 1995). Recent field work in southern California resulted in the discovery of a very unusual and undescribed species of *Hyadina*, which we describe here to highlight its anomalous morphology, especially the flexure of its wings, and its distribution.

In living and preserved specimens, the wings of this species are folded over the abdomen at two specific flexure points, similar to some species of *Stegana* Meigen (Diptera: Drosophilidae) and somewhat like the elytra of coleopteran forewings. Perhaps these flies are imitating small beetles or maybe the folding affords greater protection of the abdomen. When we initially collected specimens in the field, we first guessed that they represented a species of *Clanoneurum* Becker (Diptera: Ephydriidae), which folds its wings in a similar manner over the abdomen and which also occurs in arid, saline areas where there are host plants of the family Chenopodiaceae (Mathis and

Zatwarnicki 1995). The arid and saline conditions coupled with plant species of the family Chenopodiaceae characterize, in part, the environs of Tecopa Hot Springs (Inyo County), where we collected the type series. We were surprised, on closer inspection, to discover that the specimens represent a species of *Hyadina*. Although some species of *Hyadina* are known to have brachypterous wings (Clausen 1984), we are unaware of any congener that demonstrates this unusual folding of wings. These morphological anomalies further prompted the research that has resulted in this paper.

Tecopa Hot Springs, the provenance of the new species, is near the southern end of Death Valley in southern California, and hydrographically it is part of the Amargosa River drainage system of the Great Basin (Morrison 1991, Madsen et al. 2002). The habitat associated with the Springs is also the type locality for another shore fly, *Paracoenia wirthi* Mathis, and in just two hours of recent field work there, we found the area to be rich in shore-fly species (*Psilopa girschneri* von Röder, *Psilopa* sp (probably

new), *Ptilomyia occidentalis* Sturtevant and Wheeler, *P. pleuriseta* (Cresson), *P.* sp (probably new), *Notiphila decoris* Williston, *Typopsilopa atra* (Loew), *Allotrichoma* sp (♀), *Ilythea flaviceps* Cresson, *Lytogaster gravida* (Loew), *Pelina prospinosa* Clausen, *Calocoenia platypelta* (Cresson), *Paracoenia wirthi* Mathis, *Ephydra packardi* Wirth, *Lamproscatella occidentalis* Mathis, *Philotelma* sp (probably new), *Haloscatella nuria* (Mathis), *H. salinaria* (Sturtevant and Wheeler), *Scatella paludum* (Meigen), *Scatella* sp (frequently and questionably identified as *S. stagnalis* (Fallén); Nearctic species of *Scatella* need revision), and *Scatophila variabilis* Cresson). Moreover, the occurrence of some shore-fly species at these springs, such as the undescribed species of *Philotelma*, the new species of *Hyadina* being described here, and *Pelina prospinosa*, is somewhat atypical for their respective genera. Species of *Philotelma* and *Pelina*, for example, are more typically boreal in distribution (Clausen 1973) or at more southern latitudes, such as Chiapas, Mexico (San Cristobal de las Casas (20 km E, 2050 m)), they are found at much higher elevations (Clausen 1987).

Because there is an unusual concentration of endemic shore-fly species at Tecopa Hot Springs, we suggest that this area, including the springs, is and may have been a refugium for shore flies during interglacial periods of aridity, such as now. The area around Tecopa Hot Springs has been subjected to repeated and fluctuating climatic cycles. There have been periods of much higher rainfall, such as during the Pliocene and Pleistocene when the pluvial Lake Tecopa covered the area (Lowenstein 2002), followed by extended periods of aridity, similar to the existent climate, when aquatic systems and these springs are isolated. These fluctuating climatic events, with transitions sometimes over relatively short periods of time, may have contributed to the isolation and speciation of some of the apparently endemic shore-fly species that occur there.

METHODS

The descriptive terminology, with the exceptions noted in Mathis (1986) and Mathis and Zatwarnicki (1990a), follows that published in the *Manual of Nearctic Diptera* (McAlpine 1981). Because specimens are small, usually less than 3.5 mm in length, study and illustration of the male terminalia required use of a compound microscope. We follow the terminology for most structures of the male terminalia that other workers in Ephydridae have used (see references in Mathis 1986; Mathis and Zatwarnicki 1990a, b) and these agree with terms Zatwarnicki (1996) proposed in the "hinge" hypothesis for the origin of the eremoneuran hypopygium. The terminology for structures of the male terminalia is provided directly on Figs. 12–13, 17–20 and is not repeated for comparable illustrations of other species. The species descriptions are composite and not based solely on the holotypes. One head and three venational ratios that are used in the descriptions are defined below (all ratios are averages of three specimens (the largest, smallest, and one other)).

1. Gena-to-eye ratio is the genal height measured at the maximum eye height divided by the eye height.
2. First costal vein ratio is the straight line distance between the apices of R_{2+3} and R_{4+5} (costal section II) divided by the distance between the apices of R_1 and R_{2+3} (costal section III).
3. M vein ratio is the straight line distance along M between crossvein dm-cu and r-m divided by the distance apicad of crossvein dm-cu.
4. Wing ratio is the greatest wing width divided by the length (from base of cell bm to wing apex).

Genus *Hyadina* Haliday

Hydrina Robineau-Desvoidy 1830: 794.
Type species: *Hydrina vernalis* Robineau-Desvoidy 1830 (= *Notiphila guttata* Fallén 1813), subsequent designation,

Coquillett 1910: 553. Preoccupied (Rafinesque 1815, Coelenterata).

Hyadina Haliday in Curtis 1837: 282. [published in synonymy, first used for a taxon by Haliday 1839: 404]. Type species: *Notiphila guttata* Fallén 1813, subsequent designation, Westwood 1840: 153.—Loew 1860: 27 [generic status].—Thompson and Mathis 1981: 84 [historic review of the nomenclature].—Clausen 1983: 201–228 [Nearctic species].—Mathis and Zatwarnicki 1995: 202–207 [world catalog].

Ephydrosoma Lioy 1864: 1103. Type species: *Ephydra rufipes* Meigen 1830, monotypy.—Mathis and Zatwarnicki 1995: 202 [synonymy].

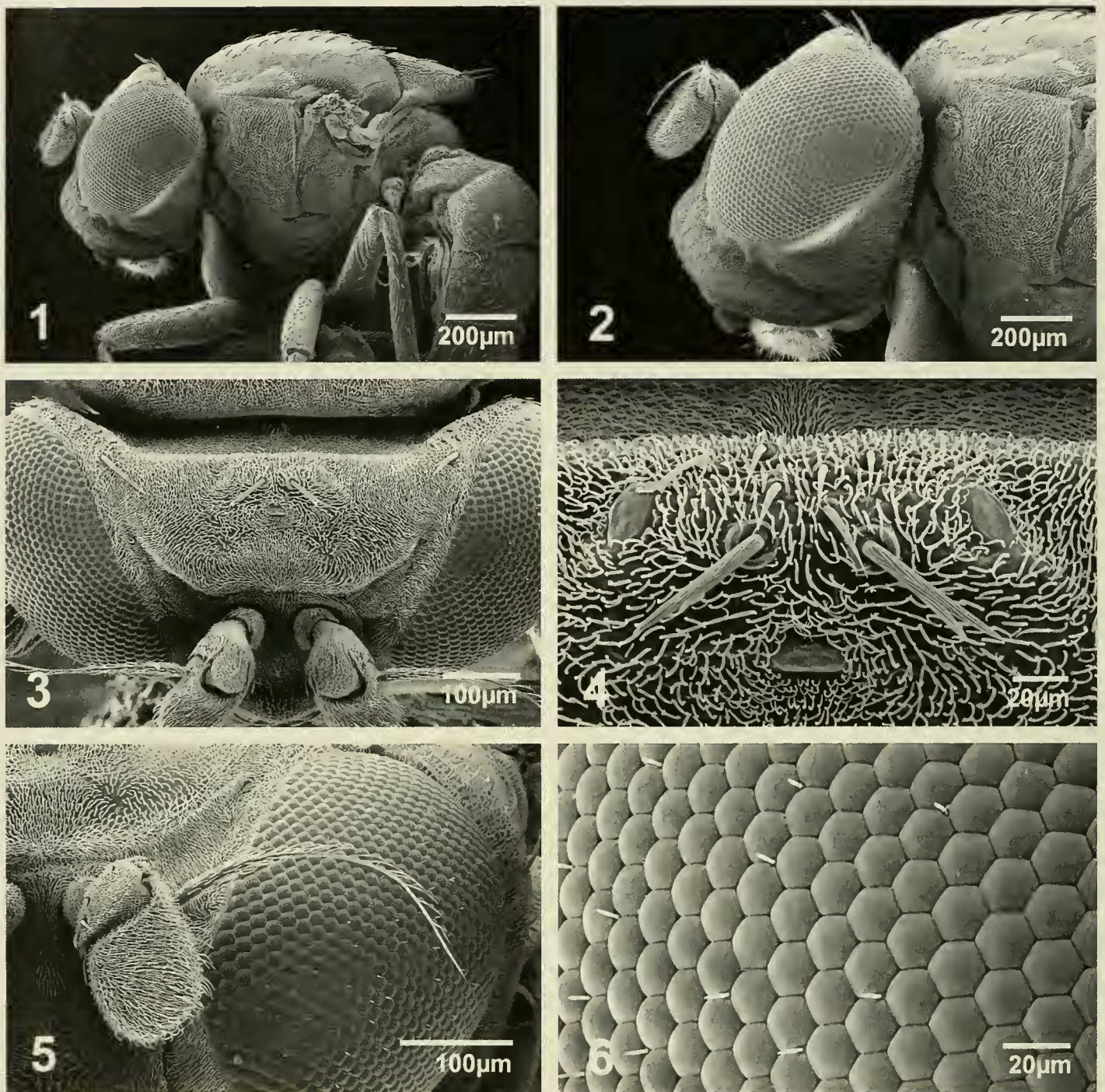
Diagnosis.—Small to medium-sized shore flies, body length 1.20–2.70 mm; mostly shiny black, often with dense microtomentum on abdomen; setation generally weakly developed.

Description.—*Head:* Frons bare to densely microtomentose. Face generally paler than frons, yellow to dark yellowish brown with golden, yellowish silver, or silvery gray microtomentum extended to gena. Gena often concolorous with ventral parafacial plate, sometimes ventral gena bare or with sparse microtomentum. Chaetotaxy: ocellar setae well developed, divergent, proclinate; pseudopostocellar setae minute, divergent, proclinate; fronto-orbital setae, minute, 3–5 pairs, proclinate; medial vertical setae well developed; lateral vertical well developed or reduced; facial setae, minute, in 2–3 rows. Antenna yellow, yellowish brown, or brown; scape, pedicel, and 1st flagellomere often darker dorsally; scape with row of setulae along apicoventral margin; 1st flagellomere microtomentose with numerous setulae; arista bearing very short rays on dorsum. Palpus prominent, yellow to dark yellowish. Gena low to moderately high.

Thorax: Mesonotum bare or with sparse to dense microtomentum, ground color pale brown to dark brown, microtomentum gold-

en, silver, velvety black or brown, often marked with distinct vittae. Scutellum trapzoidal with posterior margin slightly rounded, lateral margins sometimes with dense velvety black patches; pleura often paler than mesonotum; anepisternum bare or with dense microtomentum, often dorsally with black velvety patches; katepisternum bare or with sparse to dense microtomentum. Chaetotaxy: pre and postsutural dorsocentral setae lacking; scutellar and acrostichal setae well developed; 1 prominent supra-alar seta; anterior notopleural setae either well developed, reduced, or lacking; 1 anepisternal seta, small to minute, inserted along posteromedial margin; 1 katepisternal seta, small to minute, inserted along dorsomedial margin; 2 lateral scutellar setae, posterior seta inserted apically, lateral seta $\frac{1}{3}$ – $\frac{1}{2}$ length of posterior seta. Wing: hyaline to yellowish brown; crossvein dm-cu often with dark borders and hyaline spots in the surrounding wing areas; rarely with additional stump veins or brownish pattern in wing; costa extended to vein M. Legs: yellow, yellowish brown, to dark brown; covered by rows of minute setulae; femora and tibiae often with pattern of pale and dark areas; apical tarsomere and sometimes tarsomere 4 often darker than proximal tarsomeres. Halter knob white, yellow to yellowish brown.

Abdomen: Five abdominal tergites normally exposed in males, cerci well developed; abdominal tergites 6–8 normally exposed in female, cerci well developed; generally shiny with sparse microtomentum; ground color yellowish brown, brown to dark brown; partially bare, and usually with distinct areas of sparse to dense microtomentum; tergites setulose, with setal rows along margins. In some species tergites 2 and 3 laterally with separated plates, reaching ventral margin of abdomen. Female without fused sternites. Male terminalia: epandrium often narrow, especially dorsally, lacking setae, separated from cerci; surstylus attached with venter of epandrium, variously shaped, mostly triangular or



Figs. 1–6. Scanning electron micrographs of *Hyadina clauseni*. 1, Head and thorax, lateral view. 2, Head, lateral view. 3, Same, anterodorsal view. 4, Frons, anterodorsal view. 5, Left antenna, anterior view. 6, Left compound eye and interfacetal setae, anterior view.

rounded anteriorly, bearing 1 to several strong setae towards or at anterior margin; cercus semicircular to oval; aedeagus in most species long, slender, bearing posterodorsal process, rarely oval in ventral view, usually conspicuously arched in lateral view; phallapodeme usually long and narrow, rarely triangular in lateral view; gonite fused with hypandrium, rarely bearing anteroventral seta, usually without setae, often arcuately triangular and tapered apically in

lateral view; hypandrium shallow, directed perpendicularly [transversely] to gonites.

Discussion.—The nomenclatural issues associated with *Hyadina* are rather complex and warrant further explanation. Robineau-Desvoidy (1830) first described the genus *Hydrina* but without designating a type species. Coquillett (1910) subsequently designated *Hydrina vernalis* Robineau-Desvoidy (= *H. guttata* (Fallén), 1813) as the type species for *Hydrina*, thus making *Hydrina*

the senior synonym of *Hyadina*. Both genus-group names share *H. guttata* (Fallén) as its type species. As the senior synonym, *Hydrina* was used by some authors as the valid generic name (Cresson 1926, Frey 1945). *Hydrina*, however, is preoccupied (Rafinesque 1815, Coelenterata) and is thus not a valid genus-group name in the Ephydriidae. Although Loew (1862) noted that *Hydrina* was preoccupied much earlier, this generic name continued to be used in faunistic papers (Cresson after 1926 and almost all European authors until 1975), and until 1968 it was also used for species descriptions in the genus *Philygria* Stenhammar. This resulted in part because Cresson (1930) did not accept Coquillett's designation of *H. guttata* Fallén as the type species of *Hyadina*, assuming that it was not the senior synonym of *Hydrina vernalis*. Cresson (1930) reasoned that *H. guttata* was ineligible to be the type species because it was not a species that Robineau-Desvoidy (1830) had included in his genus, and thus Cresson (1930) designated *H. maculipennis* Robineau-Desvoidy (junior synonym of *Philygria interstincta* (Fallén 1813)) as the type species for *Hydrina*, making *Philygria* and *Hydrina* synonyms. Coquillett's designation, however, is valid (ICZN article 69.2.2., ITZN 1999) and Cresson's (1930) subsequent typification is thus superfluous. Two other subsequent designations of type species for *Hydrina* are also invalid as they did not designate an originally included species: (1) Westwood's (1840) designation of *H. punctatonervosa* (Fallén 1813) and (2) Becker's (1926) designation of *H. stictica* Meigen. Thus, *Hyadina* is the valid senior synonym for this genus.

Although Hollmann-Schirmacher (1998) recently synonymized *Lytogaster* with *Hyadina*, following the precedent of Sturtevant and Wheeler (1954), we question the basis for the synonymy and prefer recognition of both genera until we have better studied and analyzed the evidence.

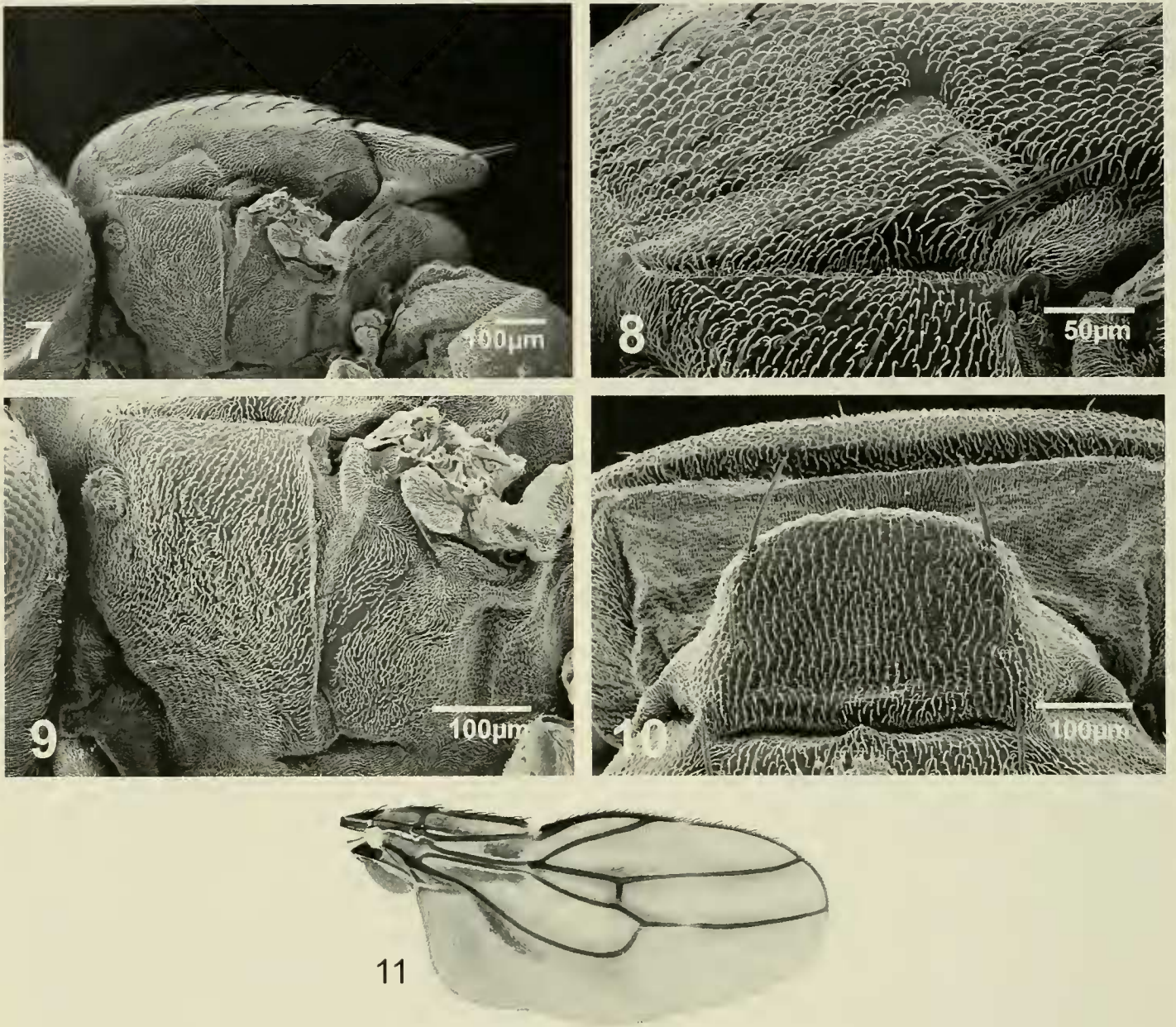
We are recognizing the subspecies of *H. furva* (*H. furva furva* and *H. furva flavipes*)

as Clausen (1983) treated them, mostly being identified on the basis of their distribution. We have not examined pertinent specimens in any further detail.

Species of *Hyadina* are found throughout the world in temperate and tropical regions (Mathis and Zatwarnicki 1995). Larvae of *Hyadina* are multivoltine, specialized consumers of soil-inhabiting Cyanobacteria (blue-green algae; Foote 1977, 1993). Adults occur in marsh-reed habitats, sedge marshes, and grass lawns adjacent to aquatic habitats (Deonier 1965, Foote 1993).

KEY TO NEARCTIC SPECIES OF *HYADINA*
(modified from Clausen 1983, 1984)

- 1. Wing with crossveins r-m and dm-cu white 2
- Wing with crossveins yellow to blackish brown 3
- 2. Only inner vertical seta present, outer vertical seta absent (Jamaica) *H. penalbivenosa* Clausen
- Both inner and outer vertical setae well developed (eastern and southwestern United States, eastern Canada, Mexico, and El Salvador) *H. albovenosa* Coquillett
- 3. Both inner and outer vertical setae well developed 4
- Only inner vertical seta present, outer seta absent 6
- 4. Scutellum with lateral and dorsal surfaces more or less similar, uniformly golden to coppery microtomentose (western United States, southwestern British Columbia, and northwestern Baja California Norte) *H. pruinosa* (Cresson)
- Scutellum with dense, black microtomentum laterally, appearing velvety, especially from a posterodorsal angle 5
- 5. Face with lateral area of dense, black microtomentum, appearing velvety, medially with dense grayish to silvery microtomentum; bearing 1 well-developed, laterooblique, fronto-orbital seta (Canada: Ontario to Nova Scotia) *H. vockerothi* Clausen
- Face uniformly densely gray to golden microtomentose; bearing 1–5 greatly reduced fronto-orbital setae (widely distributed in the United States and Canada) *H. binotata* (Cresson)
- 6. Scutellum with dense, black microtomentose patch laterally, appearing velvety 7
- Scutellum lacking dense, black microtomentose patch laterally 8
- 7. Vein R₂₊₃ appendiculate apically (northeastern United States from Iowa to Pennsylvania) *H. corona* (Cresson)
- Vein R₂₊₃ not appendiculate (northern United



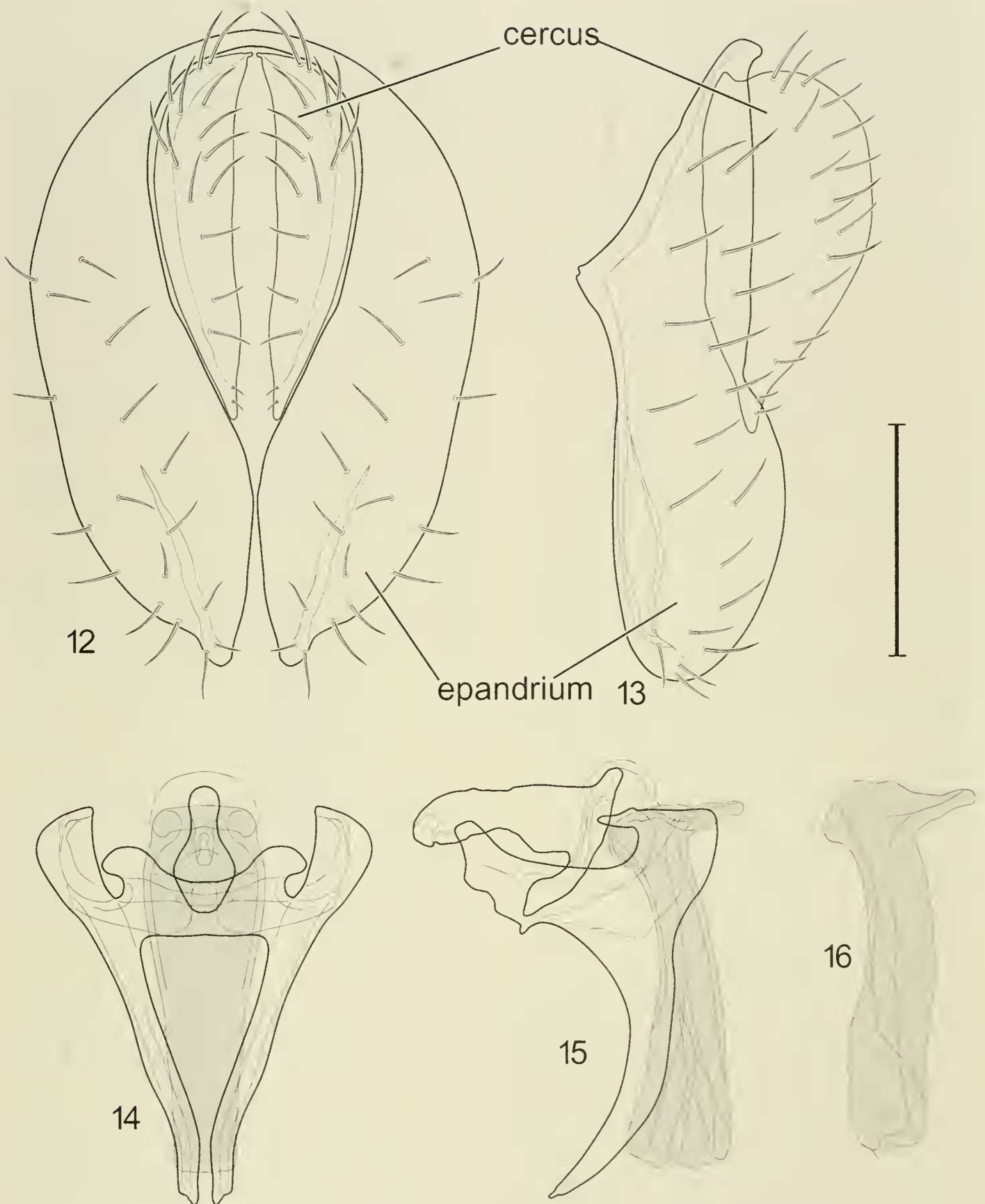
Figs. 7–11. Scanning electron micrographs of *Hyadina clauseni*. 7, Thorax, lateral view. 8, Notopleuron, lateral view. 9, Anepisternum and anepimeron, lateral view. 10, Scutellum, dorsal view. 11, Wing of *Hyadina clauseni* (length 1.55 mm).

- States and southern Canada)
- *H. subnitida* Sturtevant and Wheeler
- 8. Inner vertical seta and ocellar seta very short and stout, length less than distance between anterior ocellus and either posterior ocellus. Wing with dark patches basally (subbasally in cell r1, anterobasally in discal cell, and along posterior margin of CuA₁); vein CuA₁ not extended beyond crossvein dm-cu (southern California) *H. clauseni*, new species
- Inner vertical seta and ocellar seta well developed. Wing mostly hyaline, faintly tannish, lacking dark patches basally; vein CuA₁ extended well beyond crossvein dm-cu, nearly to wing margin 9
- 9. Eastern Canada, eastern and southeastern Unit-

- ed States and Bermuda (mesonotum lacking denser grayish stripes; legs reddish brown to brown) *H. furva furva* (Cresson)
- Southwestern United States and western Mexico (mesonotum with denser gray stripes between acrostichal setal rows and along dorso-central rows; legs yellowish to light brown) *H. furva flavida* Sturtevant and Wheeler

***Hyadina clauseni* Mathis and
Zatwarnicki, new species**
(Figs. 1–21)

Description.—Moderately small shore flies, body length: male 1.28–1.64 mm, female 1.24–1.86 mm.



Figs. 12–16. Structures of the male terminalia of *Hyadina clauseni* (California, Inyo: Tecopa Hot Springs). 12, Epandrium and cerci, posterior view. 13, Same, lateral view. 14, Aedeagus, phallapodeme, subepandrial plate, gonites, ventral view. 15, Same, lateral view. 16, Aedeagus, lateral view. Scale bar = 0.1 mm.

Head (Figs. 1–6): Frons trapezoidal (Fig. 3), anterior margin half width of posterior margin; frons and ocellar triangle moderately microtomentose, dull, more densely

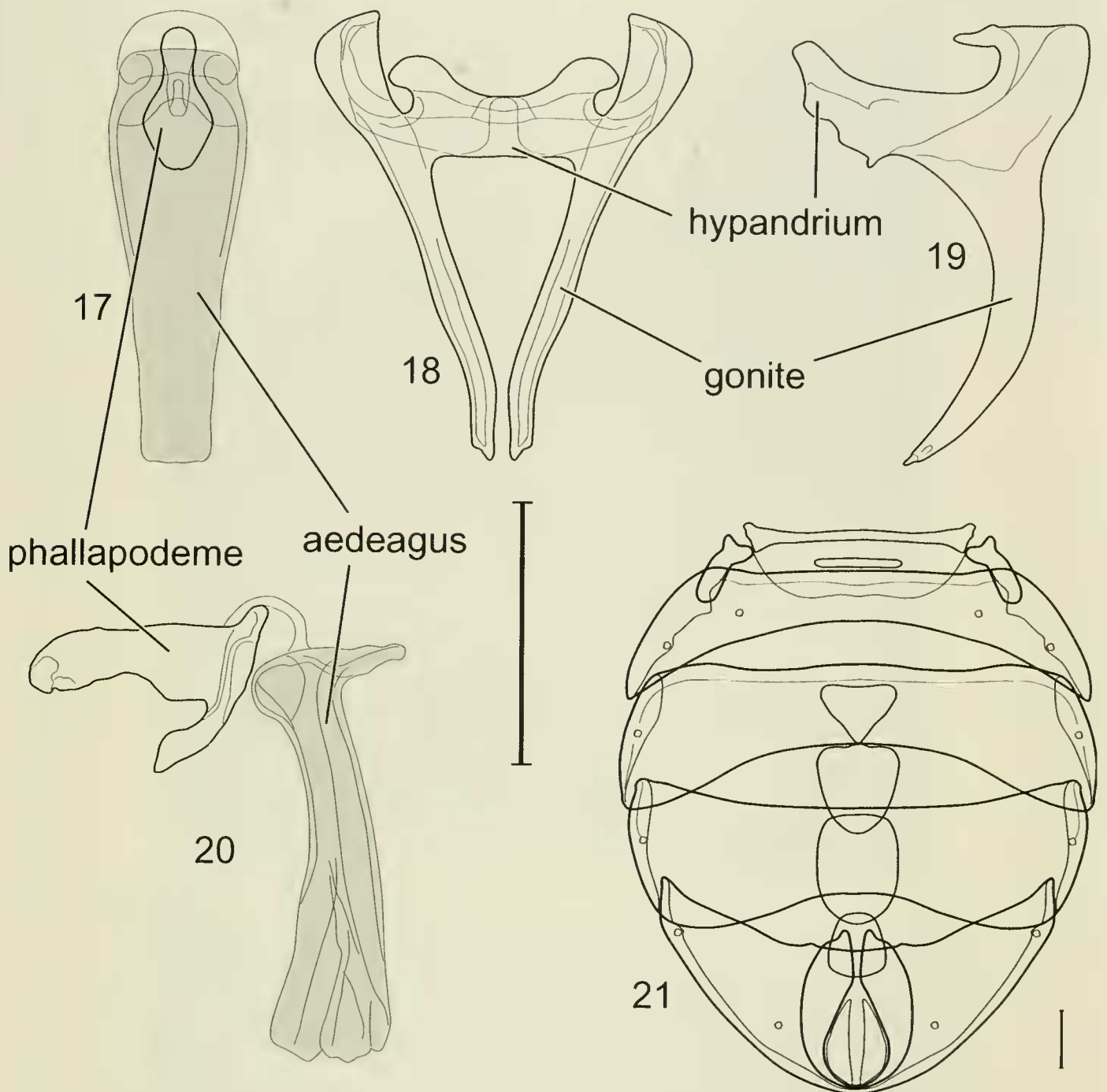
microtomentose anteromedially, grayish to tannish, otherwise subshiny, brownish black, appearing microgranulose; ocelli (Fig. 4) arranged in isosceles triangle, dis-

tance between posterior ocelli much greater than between either posterior ocellus and anteromedial ocellus; ocellar setae short, stout, length less than distance between anteromedial ocellus and either posterior ocellus; fronto-orbital setae (Fig. 2) reduced to very short, stout anterior 2–3 setulae; only medial vertical seta well developed, seta short, stout, with proclinate orientation. Scape and pedicel grayish black to black; 1st flagellomere yellowish orange basally, otherwise blackish brown to black apically; arista bearing 9–10 short hairs (Fig. 5), length of longest hairs only slightly greater than basal aristal width. Face immediately ventrad of antenna almost vertical, thereafter produced anteriorly then receded on ventral half; face moderately to densely microtomentose, whitish gray to gray, but with medial vertical stripe less microtomentose, subshiny, stripe wider dorsally; lateral, wide densely microtomentose portions of face bearing numerous setulae in 3 rows, no setulae distinctly larger than others. Parafacial gray microtomentose, lacking setulae. Eye (Fig. 2, 6) obliquely oriented, obovate, mostly bare of interfacetal setulae. Gena high; gena-to-eye ratio: male 0.35–0.38, female 0.31–0.42. Clypeus small, button-like, moderately densely, grayish microtomentose.

Thorax (Figs. 7–11): Mesonotum: Length of scutum: male 0.23–0.27 mm, female 0.26–0.31 mm; length of scutellum: male 0.11–0.13 mm, female 0.11–0.15 mm. Scutum and scutellum moderately to mostly sparsely microtomentose, dull to subshiny, brownish black, with short, gray, anterior stripes laterad of rows of acrostichal setulae and dorsocentral setulae, the latter stripes as 2 sections, being divided by transverse suture; scutellum (Fig. 10) without densely microtomentose, velvety black areas laterally, mostly subshiny to shiny; apical scutellar seta $\frac{2}{3}$ × length of basal seta; more basal seta close to apical seta, distance between apical seta twice distance between apical and more basal setae; except for posteriormost dorsocentral seta and postalar

seta, generally lacking larger setae; 2 rows of acrostichal setulae; anterior notopleural seta reduced, less than half length of posterior seta; posterior notopleural seta slightly shifted towards anterior margin of notopleuron; anepisternum and katepisternum lacking larger setae; anepisternum moderately densely microtomentose, faintly subshiny dorsally, less to ventrally; katepisternum densely gray microtomentose, especially posteriorly; anepisternum more sparsely microtomentose than anepisternum, subshiny, brownish black; dorsal half of anepisternum lacking velvety black spot around anterior spiracle. Wing (Fig. 11): generally hyaline except for brown patches subbasally in cell r1, anterobasally in discal cell, and along posterior margin of CuA₁, also faintly brownish along veins; wing unusual with 2 points of transverse folding lines: 1st and more conspicuous flexure line at level of subcostal break (subcostal break wide); 2nd line at apex of R₂₊₃ and level of crossvein dm-cu; anterior margin of wing with arched prominence between R₁ and just beyond R₂₊₃; vein R₄₊₅ and M shallowly curved forward, vein M ending at apex; crossvein r-m aligned just basad of juncture of R₂₊₃ with C; section of vein M between crossveins r-m and dm-cu short, slightly longer than crossvein r-m; vein CuA₁ not extended beyond crossvein dm-cu; wing length: male 0.65–0.68 mm, female 0.73–0.78 mm; wing ratio: male 0.30–0.54, female 0.46–0.47; width of wing: male 0.32–0.34 mm, female 0.34–0.37 mm; first costal vein ratio: male 1.22–1.45, female 1.18–1.28; M vein ratio: male 0.16–0.19, female 0.16–1.7. Halter with blackish brown knob. Legs with femora and tibiae black except for “knees”; “knees” and tarsi yellow, with apical tarsomere brown.

Abdomen (Figs. 12–21): Tergites blackish brown; abdomen in ventral view (Fig. 21) broadly oval, slightly more narrowed apically; 2nd sternite triangular, pointed posteriorly; 3rd sternite longer than wide, lateral margins tapered posteriorly, width of posterior margin less than half anterior mar-



Figs. 17–21. Structures of the male terminalia of *Hyadina clauseni* (California. Inyo: Tecopa Hot Springs). 17, Aedeagus and phallapodeme, ventral view. 18, Hypandrium and gonites, ventral view. 19, Gonite, lateral view. 20, Aedeagus and phallapodeme, lateral view. 21, Abdomen of male, ventral view. Scale bar = 0.1 mm.

gin, rounded; 4th sternite slightly longer than 3rd, longer than wide, anterior corners more angulate and posterior corners rounded; 5th sternite only slightly longer than wide, posterior margin wider than anterior margin. Male terminalia (Figs. 12–20): Epandrium in posterior view (Fig. 12) broadly oval, with narrow, deep incisions ventrally, dorsal margin thin, becoming wider with ventral $\frac{2}{3}$ about equally wide in lateral view (Fig. 13); cerci in posterior view (Fig. 12) narrowly hemispherical,

acutely pointed dorsally and ventrally, slightly wider dorsally, in lateral view (Fig. 13) more broadly hemispherical; internal genital structures as in Figs. 14–20; hypandrium in ventral view (Figs. 14–15, 18–19) like a symmetrical saddle along basal margin, apical margin more evenly and shallowly arched; gonite in lateral view (Figs. 15–16, 19) sickle shaped, narrow, tapered, pointed, apex bearing an apical setula, in ventral view both left and right gonite oriented medioapically, somewhat parallel sid-



Figs. 22–23. Habitat of *Hyadina clauseni*. 22, Tecopa Hot Springs (California, Inyo County). 22, Spring on side of hill. 23, Closeup of substrate.

ed, lateral margin shallowly sinuous; aedeagus in lateral view (Figs. 15–16) more or less narrowly rectangular, generally parallel sided, bearing a basal, narrow process, in ventral view (Figs. 14) slightly tapered from base to truncate apex; phallapodeme in lateral view (Figs. 15, 20) with narrow, elongate keel.

Type Material.—The holotype male is labeled “USA CA. Inyo: Tecopa Hot Spr[ings]. (36°52.7'N, 116°13.9'W), 17 Apr 2003, W. N. Mathis & T. Zatwarnicki/USNM ENT 00197406 [plastic bar code label]/HOLOTYPE *Hyadina clauseni* ♂ W.N. Mathis USNM & T. Zatwarnicki [red; species name, gender symbol, and “& T. Zatwarnicki” handwritten]” (USNM). Forty-five paratypes (28 ♂, 17 ♀; USNM) bear the same locality data as the holotype.

Distribution.—Nearctic: United States. (California). Although this species is presently known only from Tecopa Hot Springs (Figs. 22–23), the type locality, we would not be surprised to find specimens at other springs in the area, especially those that were or are now associated with the Amargosa River system, such as Saratoga Spring.

Etymology.—The species epithet, *clauseni*, is a genitive patronym to honor and recognize the numerous contributions of our friend and colleague, Dr. Philip J. Clausen, to the study of shore flies generally and to the tribe Hyadinini specifically.

Remarks.—Among Nearctic species of *Hyadina*, this species is perhaps most similar to *H. furva flavida* but is easily distinguished from the latter by the unique features of the wing (brown areas, flexure points, venation) and other characters as noted in the key.

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